Environmental Impacts of Pollution Risks in Euphrates Region in Iraq.

Sabreen Lateef Kareem
Babylon University-College of Engineering

Dr. Mohammad A.M. Al-Tufaily
Babylon University-College of Engineering

Abstract:

In the present study a computer program by visual basic 6.0 was made as a model required for simplifying the calculation of human health risks (risks calculations using equations) [1] in addition that in this program comparison of (HI) and (R) with EPA limitation and risk percent was also obtained.

The relationship between independent and dependent variables was found by using statistical program "Data Fit version 8.0". Independent variables include intake. While dependent variables were considered as noncarcinogen Hazard Index and Carcinogen Risk .

Then Leopold matrix method was used to assess impact by applying EIA procedure and found that air media was in more pollution in term of lead inhalation .

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الخلاصة:

في الدراسة الحالية تم إنشاء برنامج حاسوبي بَلغةِ فيجوال بيسكِ 6. كموديل بسيط ومرن لتسهيل الحسابات الخاصة بأخطار الصحة البشرية المشار لها سابقا [1] إضافة إلى انه مصمم لمقارنة النتائج النهائية مع محددات وكالة حماية البيئة.

لإيجاد العِلاقاتِ الإحصائية بين عدد من المتغيرات المستقِلة والمتغيرات المعتمدة تم استخدام طريقة تحليل الانحدار اللاخطي المنفرد باستعمال برنامج الإحصائي "Data Fit 8.0"، المتغير المستقل هو الجرع بكافة أنواعها بينما المتغيرات المعتمدة التي أُخِذَت بعين الاعتبار هي (الخطر الغير المسرطن والمسرطن).

بالاعتماد على النتائج السابقة أيضا تم تقدير الآثار البيئية للأخطار الناتجة باستعمال مصفوفة ليبولد و وجد إن الهواء كان أكثر تلوثا مقارنة بالأوساط البيئية الأخرى المدروسة بدلالة استنشاق عنصر الرصاص فيه.

Introduction:

Environmental impact assessment (EIA) is a process that requires consideration of the environment and public participation in the decision- making process of project development. An environmental impact statement (EIS) is a review document prepared for assessment in the EIA process. In some countries, EIA is direct legal requirement, while in others it is enforced indirectly under general planning, health or pollution control powers.

The National environmental Policy Act (NEPA) was introduced in the U.S in 1969 and required environmental statements to be prepared for federally funded or supported projects that were likely to have impacts on the environment. In 1973, the U.S Council of Environmental Quality (CEQ) has developed and published standard procedures for environmental statement. In 1978,the CEQ published regulations under the Act which were directed towards streamlining the process, making the output more useful to planners and decision markers , encouraging public involvement and

ensuring that the agencies follow up on their responsibilities after the approval of the EIS .in 2000 ,the Environmental impact assessment Act was issued as a legal regulation .[2].

In 1972, environmental assessment was accepted in principle at the United Nation Conference on the human environment at Stockholm when the framework of modern environmental international and national policy was laid down. The EIA consists mainly of four stages [3]. The stages include the following:

1. Screening, to decide which project should be subjected to environmental assessment. Criteria used include threshold, size of project and sensitivity of the environment.
2. Scoping is the process, which defines the key issues that should be included in the environmental assessment. Many Early EIAs were criticized because they were encyclopedic and included irrelevant information.
3. EIS preparation is the scientific and objective analysis of the scale, significant and importance of impacts identified. Various methods have been developed to assist this task.
4. Review, As environmental assessments are normally produced by the project proponent, it is usual for a review to be undertaken by a government agency or an independent review panel. The review panel guides the study and then advises the decision-makers.

In order to quantify the impact through sensible values or numbers, three approaches were mainly selected these are: [4].

- Leopold matrix
- Overlays
- Battelle environmental evaluation

Although, the last method seems powerful in obtaining reasonable ranking for the projects been assessed, the first method (Leopold matrix) will be applied in this research due to the following reasons:

1. The method is applied extensively in the reports issued by the UNEP. So that, using this method will coincide with the structural view of the national reports.
2. This method is simple to follow up, and a comparison among different projects can be clarified easily.
3. The method is comprehensive in covering physical, biological and socio-economic environment.
4. The method can be modified to (Battelle) method, when there is enough skilled data to count the environmental quality index, by applying the weights for each environmental characteristic. Thus obtaining a sum that reflects the overall assessment of the impact.

Objectives of study:

1- Preparing computer programe in (Visual Basic 6.0 Language) to compute human health risks. .

2- Developing regression models to govern the relationships between the risk requirements (dependent variables) which are: (Hazard Index (HI) and Risk (R)) and different types of intake that affecting risk (independent variables)which are: (I_{ing} , I_{der} and I_{inh}).

3- Assessing the Environmental Impact using Leopold matrix method by applying (EIA) procedure.

Description of Computer Program:

A computer program is written by using Visual Basic 6.0 Language. This program includes the required procedures of computing different types of intake and risk for different media types. its procedures are as follows:

1. Select the type of environmental media required: (water ,industrial waste water , soil , air).
2. Select the route of exposure as follow:
   - For water two routes of exposure are included, ingestion and dermal contact with water.
   - For industrial waste water two routes of exposure are included , ingestion and dermal contact with water
   - For soil two routes of exposure are included, ingestion and dermal contact with soil.
   - For air three routes of exposure are included, ingestion, dermal contact with air and inhalation.
3. Select the contaminant required.
4. Input parameters required for calculating of intake.
5. Select type of risk required as follow:
   - non carcinogen Hazard Index for the selected exposure route environmental media ,(HI).
   - carcinogen Risk for the selected exposure route environmental media, (R).

6. Select percent of risk as follows:

- PHI : Percent of noncarcinogen Hazard Index for the selected exposure route and environmental media.
- PR: Percent of carcinogen Risk for the selected exposure route and the selected environmental media.

6. Click "calculation" button.
7. The result obtained are: Intake (ingestion or inhalation or dermal contact for water or industrial waste water or soil or air) , non carcinogen (HI) or carcinogen (R) of selected environmental media and exposure route) , Risk limit (acceptable or unacceptable) , and Risk Percent(%).
8. Click "next" or" back" for new media and new exposure route.

Application of computer program:

The computer program consists of three main parts, which are:

1. The choice of type of environmental media as shown in fig (1).
2. The type of exposure route as shown in fig (2).

3.The environmental risk assessment calculation modules which contain assessment requirement as shown in fig (3)

Once the program is opened, the first page automatically appeared. At the first page, choose type of environmental media as shown in Fig.(1). Then, user automatically go to the next page, this page is consisting of type of exposure route as shown in Fig.(2) in this page all routes of exposure for selected media are appered, user can choose one of these route and can go to the next page. In this page , at first user select required contaminants from database included in this program , all parameter required are intered , selection of risk type and risk percent are made then, user can click "Calculation" button and the result automatically appeared. and can click "Next",button or "Back" button for transition to new page.and can click "Return" to go to first page the same steps should be followed similarly until final page.

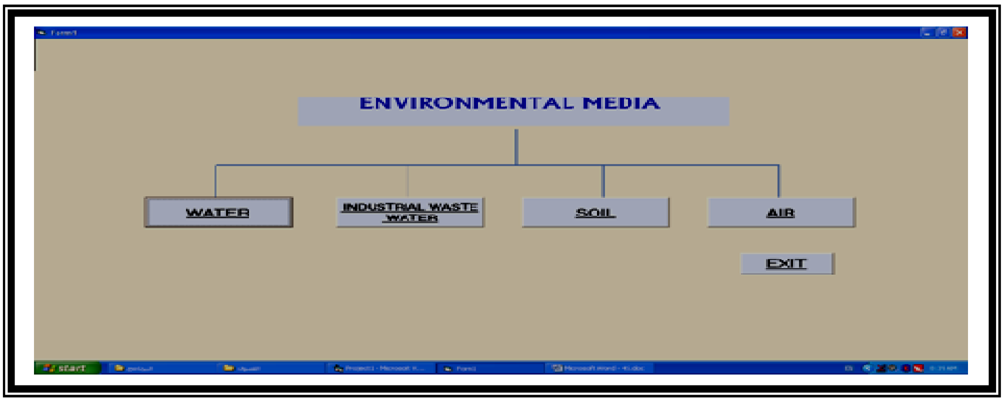
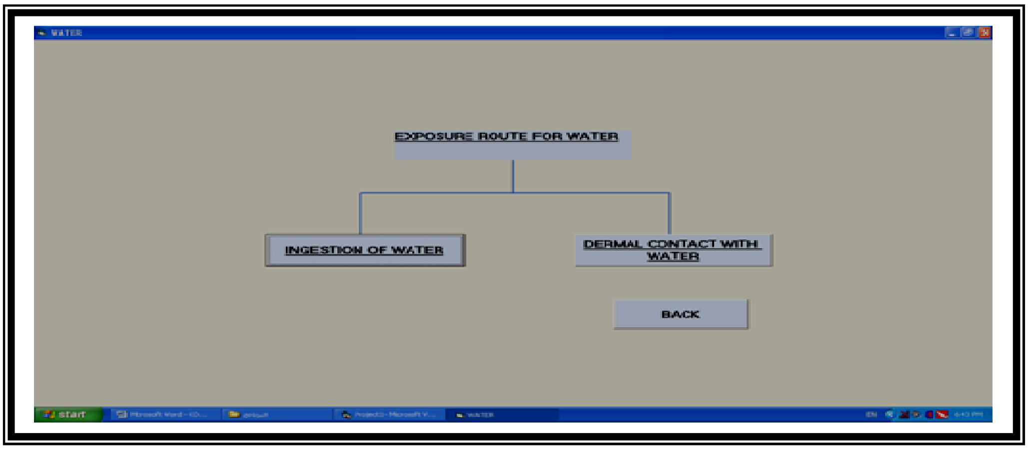


Fig.(1):Choice of environmental media.



Fig(2): Choice of ingestion of water as exposure route for water

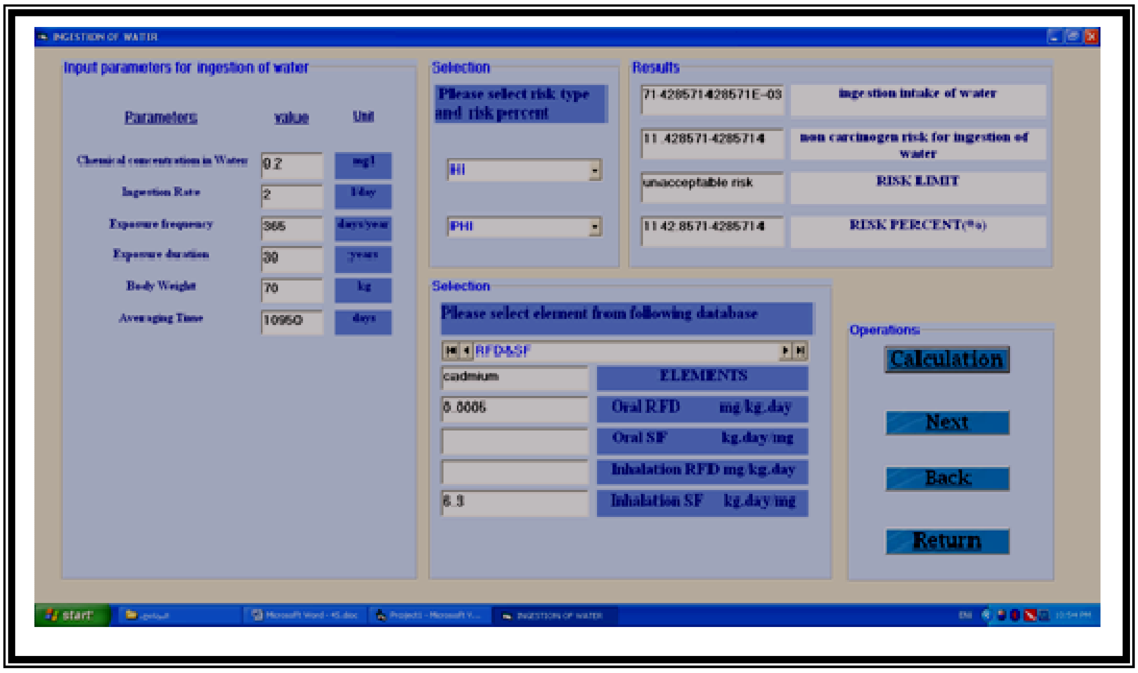


Fig.(3): Module for calculating cadmium intake and risk through ingestion of water

Analysis of Results:

For ensure the perfect operation for the program and the relations between the factors that affecting the computing of risk , the statistical models which are described was established.

The Regression Analysis Technique :

The relationship between a single variable Y, called dependent variable, and one independent variable, x are explained or modeled by a single regression analysis. The regression analysis was done by using "Data Fit" program version 8.0.

The coefficient of determination (R^2) reflects the overall accuracy of any predictive model.

1- The Dependent Variables (y)

In the present study , the Hazard Index (HI) for noncarcinogen contaminants and Risk (R) for carcinogen contaminants assumed to be the dependent variables (y).

2- The Independent Variables

Single independent variable (x) which is Intake (I) assumed in the present study . it may be Intake by ingestion (I_{ing}) or by dermal contact (I_{der}) or by inhalation (I_{inh}) according to types of exposure for each environmental media and contaminant as follow:

Table (1): Independent and dependent variables for the present study.

Environmenta media	Exposure route	Independent variable	Dependent variable
Water	ingestion	I_{ing}	HI
	dermal	I_{der}	HI
Industrial waste water	ingestion	I_{ing}	HI
	dermal	I_{der}	HI
Soil	ingestion	I_{ing}	HI or R*
	dermal	I_{der}	HI or R*
Air	ingestion	I_{ing}	HI
	dermal	I_{der}	HI
	inhalation	I_{inh}	R

*for soil media ,all risks are noncarcinogenic type , therefore dependent variable are HI except benzene which is risks are carcinogenic ,therefore its dependent variable are R.

Regression Models for Computing Risk.

In the present study, single non-linear regression models to govern the relationship between independent and dependent variables ,some example of the models obtained were shown in table (2). And model (A)was selected to determine the value of risk for all cases on the basis of the higher coefficient of determination (R^2) value which was 0.99 .The variation of the input and modeled values , (R^2), and standard error which shows the adequacy of this model can be seen in table(3).

Table (2):The proposed models.

Rank	Equation description
A	$Y=ax^b$
B	$Y = a+b*e^{-x}$

Where;
y = dependent variables.
x = the independent variables.
a , b = are model coefficients

Some examples of results of statistical analysis obtained were shown in figures 4, 5 and 6

Table (3): Results of statistical model in the present study.

Media	Route of Exposure	contaminants	y	Models	R^2	Stand. Err
Water	**Ingestion**	**Mercury**	HI	y=3333.4x^ 0.99(fig 4)	0.99	1.99E-04
		Lead	HI	y=166.7^1	0.99	2.56E-04
		Zinc	HI	y=3.3x^0.99	0.99	1.14E-04
		Nickel	HI	y=50x^1	0.99	3.3E-16
		Cadmium	HI	y=2000x^1	0.99	5.7E-16
	Dermal	**Mercury**	HI	y=16666.67x ^1(fig 5)	0.99	1.95E-10
		Lead	HI	y=833.33x^1	0.99	2.3E-10
		Zinc	HI	y=16.67x^1	0.99	1.8E-10
		Nickel	HI	y=1000x^1	0.99	2E-16
		Cadmium	HI	y=1000x^1	0.99	1.72E-16
Industrial waste water	**Ingestion**	**Mercury**	HI	y=3333.3x^1	0.99	7.7E-17
		Lead	HI	y=166.67x^1	0.99	1.42E-16
		Zinc	HI	y=3.33?^1	0.99	4.12E-19
		Chromium	HI	y=200x^1	0.99	5.62E-16
		Cadmium	HI	y=2000x^1	0.99	2.2E-18
	Dermal	**Mercury**	HI	y=17113.36x^1	0.99	0.0653
		Lead	HI	y=833.3x^1	0.99	1.4E-7
		Zinc	HI	y=16.67x^1	0.99	3.6E-09
		Chromium	HI	y=1000x^1	0.99	2.9E-08
		Cadmium	HI	y=9999.9x^1	0.99	6.07E-08
Soil	**Ingestion**	**Mercury**	HI	y=3333.32^0.99	0.99	8.9E-14
		Lead	HI	y=166.7x^0.99	0.99	1.99E-10
		Zinc	HI	y=3.32x^1	0.99	2.24E-10
		Nickel	HI	y=50x^1	0.99	1.9E-10
		Cadmium	HI	y=2000x^1	0.99	5.52E-22
		Benzene	R	y=0.029x^1	0.99	2.53E-10
		Toluene	HI	y=5x^1	0.99	3.77E-11
	Dermal	**Mercury**	HI	y=1666.67E-05x^1	0.99	8.8E-13
		Lead	HI	y=833.33x^1	0.99	2.6E-10
		Zinc	HI	y=16.67x^1	0.99	3.2E-10
		Nickel	HI	y=250x^1	0.99	2.51E-10
		Cadmium	HI	y=10000x^1	0.99	2.15E-12
		Benzene	R	y=0.058x^1	0.99	1.4E-11
		Toluene	HI	y=10x^0.99	0.99	2.4E-10
Air	**ingestion**	**Lead**	HI	y=166.7x^1	0.99	4.3E-08
	Dermal	**Lead**	HI	y=833.3x^0.99	0.99	2.48E-11
	Inhalation	**Lead**	R	y=0.0085x^1 (fig 6)	0.99	1.64E-10

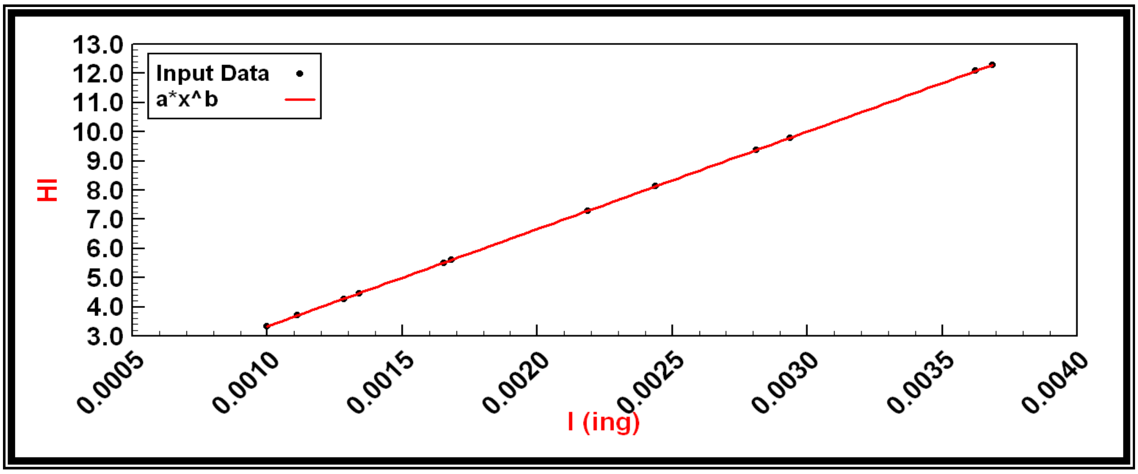


Fig (4): Ingestion Intake versus Hazard Index for mercury in water media.

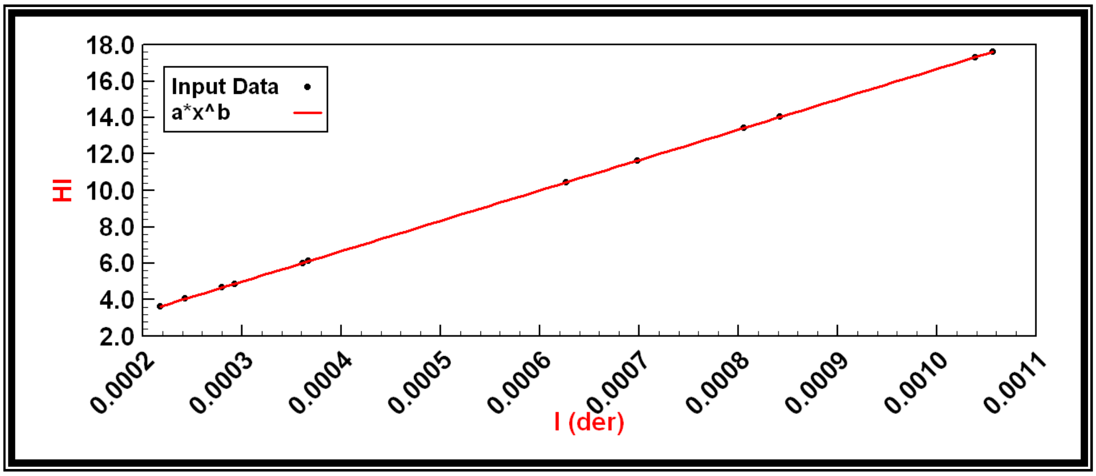


Fig (5): Dermal Intake versus Hazard Index for mercury in water media.

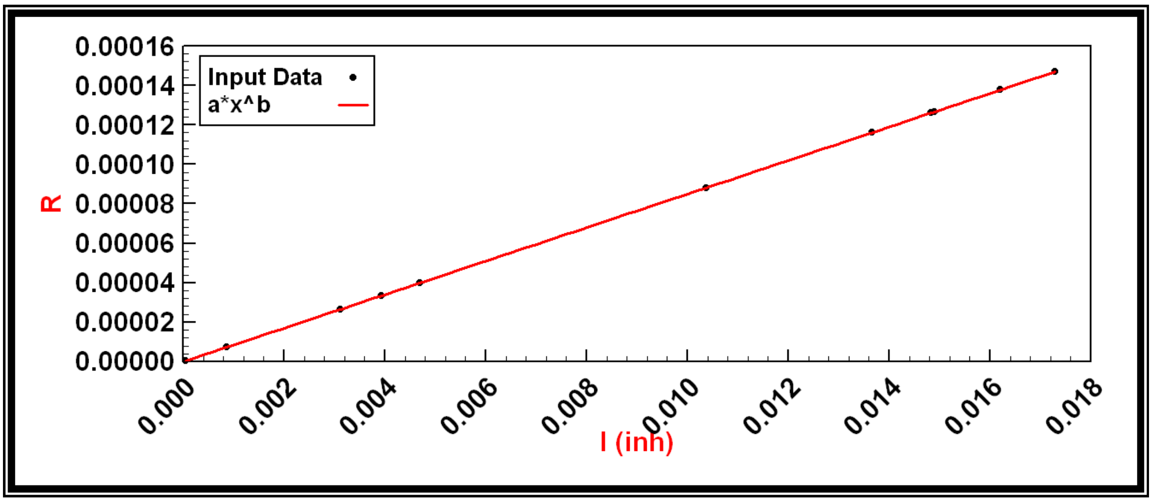


Fig (6): Inhalation Intake versus Risk for lead in air media.

By the the same manner the other relationships for statistical model described in table (3) can be obtained.

Application of EIA:

The constructions for using Leopold matrix are as follow: [4].

1. Identify all actions (located across the top of the matrix) that are part of the proposed project.
2. Under each of the proposed actions, place a slash at the intersection with each item on the side of the matrix if an item impact is possible.
3. Having completed the matrix, in the upper left-hand corner of each box with a slash, place number which indicates the MAGNITUDE of the possible impact. In the lower right-hand corner of the box place a number from 0 to 5 which indicates the IMPORTANCE of the possible impact,
   0 = no impact, 3 = moderate impact,
   1 = minimal impact, 4 = significant impact
   2 = small impact, 5 = severe impact.

The magnitude of the impacts was calculated from division non carcinogen Hazard Index (HI) or carcinogen Risk (R) of any contaminants on standard limits (non carcinogen Hazard Index (HI) =1, carcinogen Risk (R)= $1*10^{-6}$) while importance of the impacts was estimated between 0 – 5 based on carcinogen class .

Carcinogen Class of Contaminants:

In 1986 , the USEPA published general guidelines based on weight -of–evidence from epidemiological and laboratory animal test ,chemicals are placed in one of six categories as follow:

A: Carcinogenic to human.
B: Probably carcinogenic to human.*
C: possibly carcinogenic to human.
D: Not classified as human carcinogenicity.
E: Evidence of non carcinogenicity for human.

*Group B includes subgroups B1 (for chemicals having limited evidence of carcinogenicity in humans) and B2 (for chemicals having insufficient human data but sufficient animal data)[5].

Table (4):Carcinogen class of selected contaminants.

Contaminants.	Carcinogen class .	Value of importance (a)
Mercury	C	5
Lead	B2	5
Zinc	D	3
Nickel	D	4
Chromium.	A	5
Cadmium	B1	5
Benzene	A	5
Toluene	D	4

Some Examples of Matrices Resulted in Present Study:

Matrix (1): Leopold Matrix of Ingestion of Water for adult near textile factory intake.

Environmental media \ Pollutants	Hg	Pb	Zn	Ni	Cr	Cd	C6H6	C7H8	Total
Water Environment	(1)5 / 4.465(2)	5 / 0	3 / 0	4 / 0	0 / 0	5 / 0	0 / 0	0 / 0	22 / 4.465
	22.325(3)	0	0	0	0	0	0	0	22.325(4)
	100(5)	0	0	0	0	0	0	0	100
Industrial Waste Water Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Soil Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Air Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0

(1):importance for mercury =5.
(2):magnitude= HI/1=4.465.
(3):impact=magnitude*importance.
= 5*4.465
=22.325.
(4):sum. of impact =22.325.
(5):percent of total impact(impact/sum of impact)*100

Matrix (2): Leopold Matrix of Ingestion of Water for child near textile factory intake.

Environmental media \ Pollutants	Hg	Pb	Zn	Ni	Cr	Cd	C6H6	C7H8	Total
Water Environment	5 / 9.792	5 / 1.302	3 / 0	4 / 0	0 / 0	5 / 2.125	0 / 0	0 / 0	22 / 13.219
	48.96	6.51	0	0	0	10.625	0	0	66.095
	73.7	9.8	0	0	0	16.9	0	0	100
Industrial Waste Water Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Soil Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Air Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0

Matrix (5.3): Leopold Matrix of dermal contact of Water for adult near textile factory intake.

Environmental media \ Pollutants	Hg	Pb	Zn	Ni	Cr	Cd	C6H6	C7H8	Total
Water Environment	5 / 4.875	5 / 0	3 / 0	4 / 0	0 / 0	5 / 1.0579	0 / 0	0 / 0	22 / 5.9329
	24.375	0	0	0	0	5.2895	0	0	29.66
	82.2	0	0	0	0	17.8	0	0	100
Industrial Waste Water Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Soil Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Air Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0

Matrix (4): Leopold Matrix of dermal contact of Water for child,Hilla, near textile factory intake.

Environmental media \ Pollutants	Hg	Pb	Zn	Ni	Cr	Cd	C6H6	C7H8	Total
Water Environment	5 / 14.03	5 / 1.865	3 / 0	4 / 0	0 / 0	5 / 3.0447	0 / 0	0 / 0	22 / 18.935
	70.15	9.325	0	0	0	15.2	0	0	94.675
	74.1	9.8	0	0	0	16.1	0	0	100
Industrial Waste Water Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Soil Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Air Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0

Matrix (5): Leopold Matrix of Ingestion of Industrial Waste Water for adult for Hilla Textile Factory.

Environmental media \ Pollutants	Hg	Pb	Zn	Ni	Cr	Cd	C6H6	C7H8	Total
Water Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Industrial Waste Water Environment	5 / 1.52	5 / 0	3 / 0	0 / 0	5 / 4.178	5 / 0	0 / 0	0 / 0	23 / 5.698
	7.6	0	0	0	20.89	0	0	0	28.49
	26.7	0	0	0	73.3	0	0	0	100
Soil Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Air Environment	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0

Matrix (6): Leopold Matrix of Ingestion of Industrial Waste Water for child for Hilla Textile Factory.

Pollutants / Environmental media	Hg	Pb	Zn	Ni	Cr	Cd	C6H6	C7H8	Total
Water Environment	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Industrial Waste Water Environment	5	5	3	0	5	5	0	0	23
	3.333	1.031	0	0	9.163	0	0	0	13.527
	17.155	5.175	0	0	45.815	0	0	0	68.145
	25.2	7.6	0	0	67.2	0	0	0	100
Soil Environment	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Air Environment	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0

Matrix (7): Leopold Matrix of dermal contact of Industrial Waste Water for adult for Hilla Textile Factory.

Pollutants / Environmental media	Hg	Pb	Zn	Ni	Cr	Cd	C6H6	C7H8	Total
Water Environment	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Industrial Waste Water Environment	5	5	0	0	5	5	0	0	23
	1.695	0	0	0	4.561	0	0	0	16.256
	8.475	0	0	0	22.805	0	0	0	31.28
	27.1	0	0	0	72.9	0	0	0	100
Soil Environment	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Air Environment	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0

Matrix (8): Leopold Matrix of dermal contact of Industrial Waste Water for child for Hilla Textile Factory.

Pollutants / Environmental media	Hg	Pb	Zn	Ni	Cr	Cd	C6H6	C7H8	Total
Water Environment	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Industrial Waste Water Environment	5	5	3	0	5	5	0	0	23
	4.776	1.4776	0	0	13.128	0	0	0	19.382
	23.88	7.388	0	0	65.45	0	0	0	96.908
	24.6	7.6	0	0	67.8	0	0	0	100
Soil Environment	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Air Environment	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0

Summary of EIA:

Table (5):Summary of EIA.

<table>
<tr><th>Environmental media</th><th>Exposure routes</th><th>Contaminants</th><th>d=c/e</th><th>Rank of contaminants</th><th>∑d</th><th>Rank of routes</th><th>Rank of media</th></tr>
<tr><td rowspan="8">Water</td><td rowspan="4">Ingestion</td><td>Hg</td><td>310.1*</td><td>1</td><td rowspan="4">389.688</td><td rowspan="4">5</td><td rowspan="8">3</td></tr>
<tr><td>Pb</td><td>21.7</td><td>3</td></tr>
<tr><td>Ni</td><td>4.188</td><td>4</td></tr>
<tr><td>Cd</td><td>53.7</td><td>2</td></tr>
<tr><td rowspan="4">Dermal</td><td>Hg</td><td>301.7</td><td>1</td><td rowspan="4">399.4</td><td rowspan="4">4</td></tr>
<tr><td>Pb</td><td>21.7</td><td>3</td></tr>
<tr><td>Ni</td><td>5.9</td><td>4</td></tr>
<tr><td>Cd</td><td>70.7</td><td>2</td></tr>
<tr><td rowspan="6">Industrial Waste Water</td><td rowspan="3">Ingestion</td><td>Hg</td><td>230.33**</td><td>2</td><td rowspan="3">575.35</td><td rowspan="3">3</td><td rowspan="6">2</td></tr>
<tr><td>Pb</td><td>4.52</td><td>3</td></tr>
<tr><td>Cr</td><td>340.5</td><td>1</td></tr>
<tr><td rowspan="3">Dermal</td><td>Hg</td><td>230.23</td><td>2</td><td rowspan="3">575.46</td><td rowspan="3">2</td></tr>
<tr><td>Pb</td><td>4.53</td><td>3</td></tr>
<tr><td>Cr</td><td>340.7</td><td>1</td></tr>
<tr><td rowspan="2">Soil</td><td>Ingestion</td><td>C6H6</td><td>200</td><td>1</td><td rowspan="2">200</td><td rowspan="2">6</td><td rowspan="2">4</td></tr>
<tr><td>Dermal</td><td>C6H6</td><td>0</td><td>-</td></tr>
<tr><td rowspan="3">Air</td><td>Ingestion</td><td>Pb</td><td>0</td><td>-</td><td rowspan="3">8100</td><td rowspan="3">1</td><td rowspan="3">1</td></tr>
<tr><td>Dermal</td><td>Pb</td><td>0</td><td>-</td></tr>
<tr><td>Inhalation</td><td>Pb</td><td>8100***</td><td>1</td></tr>
</table>

* 310.1=[(c/e) for adult and child at Hilla near textile factory intake +(c/e)for adult and child at Hashimya city].

**230.33=[(c/e) for adult and child at Hilla textile factory +(c/e)for adult and child at Hilla slaughter +(c/e)for adult and child at Hilla educational hospital +(c/e) for adult and child at General company for chemical industries].

***8100=[(c/e) for adult and child for all selected sites.

Conclusion:

1- The computer program can be considered as a simple method for computing risk because it takes into account more than one environmental media and exposure route in addition to its including RfDs and SF values for large number of element and compound and its checking with hand results shows a good agreement.

2-In the Leopold matrix method there is no a standardized way of assessing the scores, nor is there a means of assigning weight to different impacts to determine relative importance**.** For this reason**,** the scoring values in the matrix present the author's opinion.

3- By applying EIA procedure, it was found that air media was in high pollution in terms of lead compared with other selected media.

4-Statistical model was another good method for computing environmental risk because R^2 was about 0.99 and standard error was low to a high limit

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